CASE REPORT

Elemental mercury mixed with alcohol injected intravenously as a suicide attempt

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Accepted 16 September 2015

SUMMARY

A 22-year-old woman was admitted to the emergency department with symptoms of chest discomfort after a suicide attempt by injecting intravenously the amount of mercury extracted from 3 thermometers mixed with alcohol. At presentation, the patient was well oriented with normal vital signs, but a few hours later she presented an abrupt deterioration of her mental status, with confusion, disorientation, tremor and finally stupor. She was transferred to the intensive care unit for monitoring and therapy. A nasogastric tube was immediately placed and the patient received treatment with a chelating agent dimercaptosuccinic acid (DMSA)/succimer 800 mg orally three times a day, a dosage decided on the basis of her body weight, plus phenytoin 125 mg intravenously three times a day. Two hours after treatment initiation, the patient reported a remarkable improvement of her symptoms. However, she experienced seizures during a 6-month period after her discharge.

BACKGROUND

Exposure to metallic mercury is usually occupational (mines, jewellery industry, dentistry, medicine) by inhalation of its vapour or ingestion of mercury salts, but can occur in many ways due to the availability of liquid mercury at homes, offices and hospitals. In fact, children can be easily exposed, by ingestion or by absorption through the skin, because its shiny, silvery appearance can make it particularly attractive. A small amount of mercury can be absorbed directly through the intact skin, but its release into the circulation is slow and of little clinical significance.¹

Intravenous injection of elemental mercury is very uncommon—in fact, less than 100 cases have been reported in the past 50 years worldwide²—and it is usually related to attempted suicide,³ attempted homicide,⁴ psychiatric conditions or drug addiction.^{5–8} In this case report, the patient used the liquid mercury obtained from three thermometers found at home, mixed it with alcohol and injected it into her left forearm. To the best of our knowledge, this is the first case of intravenous injection of elemental mercury reported in Greece and maybe the first case of intravenous injection of elemental mercury mixed with alcohol worldwide.

CASE PRESENTATION

A 22-year-old woman presented to the emergency department (ED) reporting heaviness in the chest and pain and a sense of compression in the pericardium area, which started 2 h previously.

She reported a suicide attempt by injecting herself on the left forearm, the containment of mercury of three thermometers mixed with alcohol, intravenously. She also reported pain at the injection site, where an erythematous area, hot and painful at palpation, was observed. The patient had no medical history. On her arrival at the ED, she was conscious, oriented in time and in space with a Glasgow Coma Scale (GCS) score equal to 15.

On examination, her blood pressure was 120/60 mm Hg, temperature 36.6°C, heart rate 90 bpm, regular respiration 17 breaths/min, O₂ saturation 96% with pulse oximetry at room temperature. Nothing was remarkable in her respiratory, cardiovascular or abdominal examinations. The ECG was normal, with sinus rhythm and normal heart rate (90 bpm). Arterial blood gas in FiO₂ 21% showed PaO₂ 104 mm Hg, PCO₂ 26.5 mm Hg, pH 7.58, HCO₃ 25.1 mmol/L.

Radiography revealed radiopaque deposits of mercury, mainly in the middle and lower lobes of bilateral lung fields and in the pericardium, intestine, kidneys and liver (figures 1 and 2). CT confirmed deposits of mercury in the lung fields and kidneys (figures 3–5). Echocardiogram and abdominal ultrasound were normal.

The laboratory tests were normal and the blood chemistry and indices are shown in table 1.

Urine levels of mercury were >60 µg/L and blood levels >35 µg/L when non-toxic levels are <10 and <6 µg/L for urine and blood, respectively.

The patient remained stable for 2–3 h after admission, but her mental status suddenly deteriorated, showing confusion, disorientation, tremor and finally stupor. Her new GCS score was 9, blood pressure 120/55 mm Hg, heart rate 92 bpm,

Figure 1 Presence of radiopaque deposits of mercury, mainly in the middle and lower lobes of bilateral lung fields.

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To cite: Karatapanis S, Lamprianou F, Ntetskas G, et al. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2014-207075

Figure 2 Presence of radiopaque deposits of mercury, mainly in the right upper and lower quadrants of the abdomen.

temperature 37.4°C and respiration 17 breaths/min. Given the severity of her condition, she was transferred to the intensive care unit (ICU) for monitoring and therapy.

TREATMENT

A nasogastric tube was immediately placed and the patient started treatment with a chelating agent dimercaptosuccinic acid

Figure 3 Presence of radiopaque deposits of mercury in the posterior segments of the left upper lobe.

Figure 4 Radiopaque deposits of mercury located in the left kidney.

(DMSA)/succimer 800 mg orally three times a day, a dosage suited to her body weight according to the Poison Control Center. She also underwent a neurological examination, and the neurologist suggested treatment with phenytoin 125 mg intravenously three times a day.

Two hours after the initiation of treatment, her mental status improved remarkably, and she was alert, oriented and able to communicate. No other symptoms occurred, except for mild chest pain during deep breathing.

In the meantime, thorax, abdomen and brain CT scans were performed. The chest CT scan revealed multiple radiopaque nodes in the middle and lower lobes of both lungs, a small pleural effusion and a few mercury deposits on the pericardium. The abdominal CT scan showed multiple deposits on the liver, left kidney, spleen and paraspinal muscles. The brain CT scan showed no abnormalities.

Figure 5 Radiopaque deposits of mercury located in the left kidney and the lower edge of the liver.

Table 1 Laboratory findings at presentation

Full blood count		Cardiac markers		Biochemical analysis			
WCC	10.41 K/ μ L	Troponin-I	0.00 ng/mL	Glucose	105 mg/dL	TBIL	0.70 mg/dL
RBC	4.77 K/ μ L	CK-MB mass	1.0 ng/mL	Urea	18 mg/dL	DBIL	0.23 mg/dL
HGB	14.9 g/dL	Myoglobin	53.8 μ g/mL	Creatinine	0.96 mg/dL	SGPT	15 U/L
HCT	43.9%			Sodium	137 mmol/L	SGOT	18 U/L
PLT	280			Potassium	3.8 mmol/L	γ -GT	21 U/L
				CRP	0.14 mg/dL	LDH-P	236 U/L
						CK	65 U/L

γ -GT, γ -glutamyltransferase; CK, creatine kinase; CK MB, CK-myocardial band; CRP, C reactive protein; DBIL, serum direct bilirubin; HCT, Haematocrit; HGB, haemoglobin; LDH-P, lactate dehydrogenase; PLT, platelet count; RBC, red blood cell; SGOT, serum glutamic oxaloacetic transaminase; SGPT, serum glutamic pyruvic transaminase; TBIL, serum total bilirubin; WCC, white cell count.

The chelating therapy with succimer continued for 5 days with the initial dosage of 800 mg orally three times a day at the ICU. The patient was transferred to the Internal Medicine Department and continued therapy for another 14 days at a lower dosage (600 mg orally three times a day). The patient was discharged 20 days after her admission remarkably improved.

OUTCOME AND FOLLOW-UP

During her hospitalisation in the wards, she developed seizures with tongue biting on the left side of her tongue. She was immediately treated with diazepam 10 mg intravenously and the symptoms regressed.

The neurologist who evaluated the patient considered this episode as an epileptic crisis and suggested an EEG and started treatment with valproate acid 300 mg orally two times a day. The patient refused to undergo EEG, and despite the treatment, she developed two more seizure episodes over the following days, therefore the dosage was increased in 500 mg two times a day. The patient was discharged after 20 days of hospitalisation with significant improvement. A psychiatric evaluation was also performed, but the psychiatrist considered that no pharmacological treatment was necessary.

On a follow-up visit 6 months later, the patient mentioned that she interrupted her treatment without consulting a physician, and that ever since she had sporadically had seizures. During her hospitalisation, a brain CT scan was performed but as expected there was no evidence of mercury deposits in the brain.

On a follow-up visit 2 years later, the patient was stable without any further seizures, remaining on antiepileptic therapy. However she reported that her menstrual cycle was altered significantly, with an increase in the blood loss as well as the duration of menstruation.

DISCUSSION

Intravenous injection of elemental mercury is very uncommon and the clinical symptoms and signs depend on the quantity of mercury injected and its distribution at the tissues. It is important to notice that most of the patients described in the literature suffered only a few of the toxic effects of mercury; usually, no acute lethal consequences are to be expected, despite the fact that in some cases the dose of mercury injected was high.^{9–13} To the best of our knowledge, only two deaths following subcutaneous injection and oral self-administration of mercury have been reported by Chodorowski *et al*,¹⁴ where the cause of death was renal failure in one patient and empyema in the lung in the other.

In cases of subcutaneous and intravenous metallic mercury injection, patients can present with an inflammatory mass at the

site of injection, formed by aggregations of mercury probably as a local foreign-body-type reaction to metallic mercury. It has been suggested that there is lymphatic and vascular migration with development of fibrosis, abscesses and granulomas.^{15–19} This can be seen during the physical examination of the patient; it can appear on an X-ray examination,²⁰ or in sonography.²¹ Treatment of the granulomas by a subcutaneous metallic mercury injection has usually been by surgical excision.^{20 22–24} Sometimes mercury aggregations can be evident at the time of the surgery.²⁰ In our case, the patient presented with an erythematous area on the left forearm, hot and painful at palpation, at the injection site, which was treated with antibiotics. On a follow-up visit 6 months later, a small palpable mass remained in place, but the patient refused to remove it despite the surgeon's suggestion.

Once mercury is injected intravenously, it can quickly cross-over into the systemic circulation¹⁴ and be distributed into the tissues, particularly in the lungs,⁵ where it can cause pulmonary embolism and infarction.²⁵ Patients have been reported to present with dyspnoea, chest pain, dry cough, hypoxaemia and altered carbon monoxide diffusing capacity,^{6 26 27} but in other cases no respiratory symptoms occurred, and embolism was revealed only by radiographic findings.²⁸ Our patient presented with chest discomfort and pain. Pulmonary auscultation revealed no abnormalities and arterial blood oxygen saturation in breathing ambient air was 98%. However, when X-rays and a thoracic CT scan were performed, several metallic deposits of different sizes were found in both lungs, as well as in the pericardium, myocardium and right pleura.

In most cases of mercury poisoning the mercury densities are located in the lungs, but sometimes the mercury reaches the systemic circulation through the pulmonary vasculature and from there find its way to the heart, kidneys, liver, intestine, spleen, testicles and probably ovaries.^{28–32} Indeed, deposits of mercury and their toxic effects on the ovaries have only been reported in *in vitro* studies on animals.^{33 34} In our case, no deposits of mercury were noticed in the ovaries in the first abdominal CT scan, but the patient in the latest follow-up visit (2 years) reported significant menstrual changes including alternation of the quantity of blood loss and duration of the menstruation. To the best of our knowledge, this is the first case of a patient referring such symptoms after an intravenous injection of mercury.

Kidneys can also be involved. Once the metallic mercury is injected in the body, it can be ionised and oxidised into mercuric salts that bind sulfhydryl groups of proteins, with the consequence of denaturation of proteins and enzymes, inhibiting or decelerating critical enzymatic processes particularly in the central nervous system and the kidneys.^{35–40} The excretion

of metallic mercury is primarily via the urine, faeces and saliva,^{25 28 29 41} so it seems more than plausible that mercury can provoke a direct damage to the renal tubules. Kidney impairment can be attributed to tubular necrosis, autoimmune glomerulonephritis or granulomatous interstitial nephritis.^{42–44} In our case, no kidney dysfunction was noticed.

Brain dysfunction is not very common in mercury toxicity, because metal mercury is not able to reach the brain thanks to the blood–brain barrier, but it has been found in neonatal brain where the blood–brain barrier is still not completely formed.⁴⁵ Some experts postulate that even though metal mercury cannot pass through the blood–brain barrier, its derivatives such as methylmercury can readily pass and act as a neurotoxic agent causing adverse effects on the developing brain.⁴⁶ There are no references that would indicate a human metabolic process that can perform this mercury transformation. However, it is believed that once metal mercury comes in contact with microorganisms present in the mouth or the intestine, such as yeast, staphylococci, streptococci, *Escherichia coli*, *Enterobacter*, *Candida albicans* and *Saccharomyces cerevisiae*, this transformation can be achieved.^{47–50} Methylmercury is a highly lipophilic compound and has the capability of passing various membranes, including the placental barrier and the blood–brain barrier.⁵¹

Neurological symptoms have been reported in many cases of mercury poisoning and most of them have been attributed to the toxic effect of mercury on proteins, enzymes and its capability of interrupting the uptake and release of neurotransmitters.^{35–40} Polyneuropathy due to inorganic mercury intoxication has been reported by Zampollo *et al*⁵² and Chu *et al*.⁵³ Chu examined the sural nerve of the patient by biopsy and noticed axonal degeneration, concluding that exposure to inorganic mercury can lead to motor polyneuropathy. Recently, Ragothaman *et al*⁵⁴ suggested that elemental mercury poisoning probably causes cortical myoclonus.

In our case, the patient initially presented with progressive confusion, disorientation and stupor, symptoms that regressed after the administration of succimer (800 mg orally three times a day), intense rehydration and phenytoin 125 mg intravenously three times a day, under strong observation in the ICU. Later on, when the patient was transferred to the wards, she developed seizures with tongue biting on the left side of the tongue. She was immediately treated with diazepam 10 mg intravenously and the symptoms regressed. The neurologist, after evaluating the patient, considered this episode as an epileptic crisis and suggested an EEG and started treatment with valproate acid 300 mg orally two times a day. The patient refused to undergo EEG, and despite the treatment, she developed two more seizure episodes, therefore the dosage was increased in 500 mg two times a day. On a follow-up visit 6 months later, the patient mentioned that she interrupted the treatment without consulting any physician and that ever since she sporadically had seizures. During her hospitalisation, a brain CT scan was performed but as expected there was no evidence of mercury deposits in the brain.

Patient's perspective

During my hospitalisation, I received a brain CT scan, there was no evidence of mercury deposits on the brain and I was advised to be re-examined.

Learning points

- ▶ The common clinical presentation of intravenous or subcutaneous elemental mercury poisoning included fibrosis, abscesses and granulomas at the site of injection, dry cough, dyspnoea, chest pain and hypoxaemia in case of pulmonary embolism and infarction, and acute kidney failure due to tubular necrosis or granulomatous interstitial nephritis. Cognitive impairment and signs of brain damage are rare as the blood–brain barrier inhibits access of elemental mercury to the brain.
- ▶ Evaluation should include whole-body radiography and full-body scanning as well as urinary and serum mercury levels.
- ▶ Treatment should be personalised according to the patient's symptoms and general clinical condition.
- ▶ Given that not all long-term effects of metallic mercury poisoning are known, physicians should consider heavy metal injections when evaluating a patient with a history of depression, past suicide attempts and epilepsy.
- ▶ Possible repercussions of metallic mercury poisoning on the reproductive system of women should be considered and evaluated if possible in experimental models.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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